SECTION 3.8

Nokesville, VA

SECTION 3.8

DATA PRESENTATION

The following section contains the tables, site photos, and spectrum photos pertaining to the site location measured.

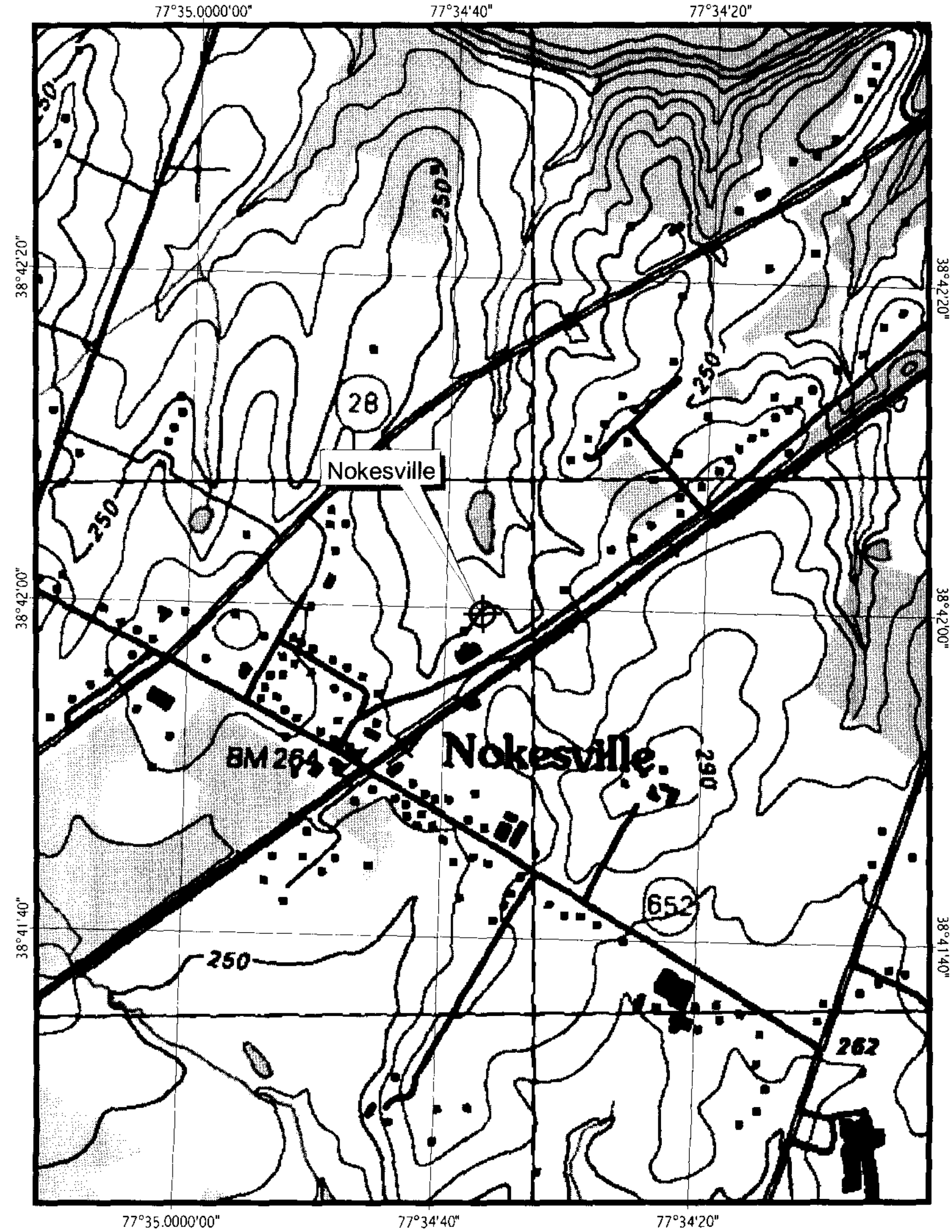
3.8 XM Radio – Nokesville, VA

- o Table 3.8-1 presents a site data sheet including all pertinent site information.
- o Figure 3.8-1 contains a plot plan which indicates the test antenna location throughout the measurements.
- o Figures 3.8-2 are the photographs depicting the test site.
- o Figures 3.8-3 through 3.8-6 are the RF spectrum photographs depicting the interference environment at the test site.

TABLE 3.8-1

MEASUREMENT SITE DATA SHEET

1. SYSTEM NAME:	XM Radio	
2. CITY AND STATE:	Nokesville, VA	
3. SITE IDENTIFICATION:	Nokesville	
4. COORDINATES: (NAD 1983)	LATITUDE: LONGITUDE:	38° 42' 03.4" N 77° 34' 36.9" W
5. SITE TYPE:	Rural	
6. MEASUREMENT DATES & TIMES:	January 21, 2002	1430-1530

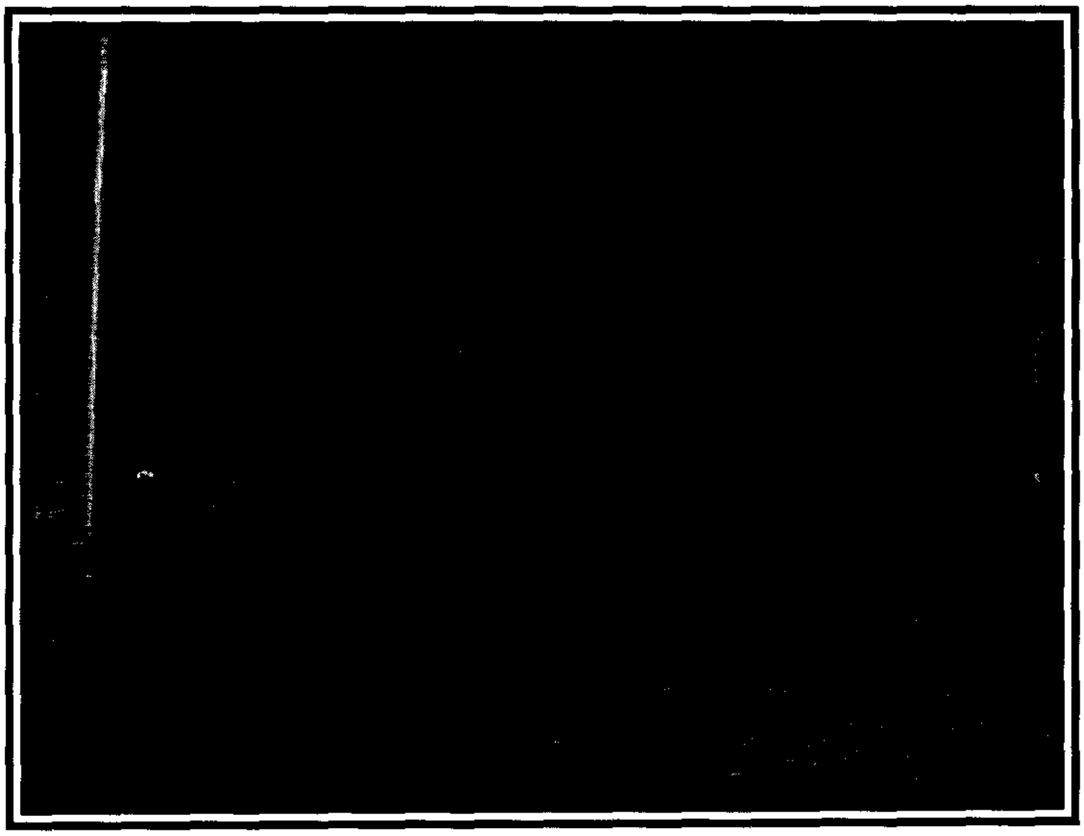


COMSEARCH

XM RADIO

FIGURE 3.8-1

North



East

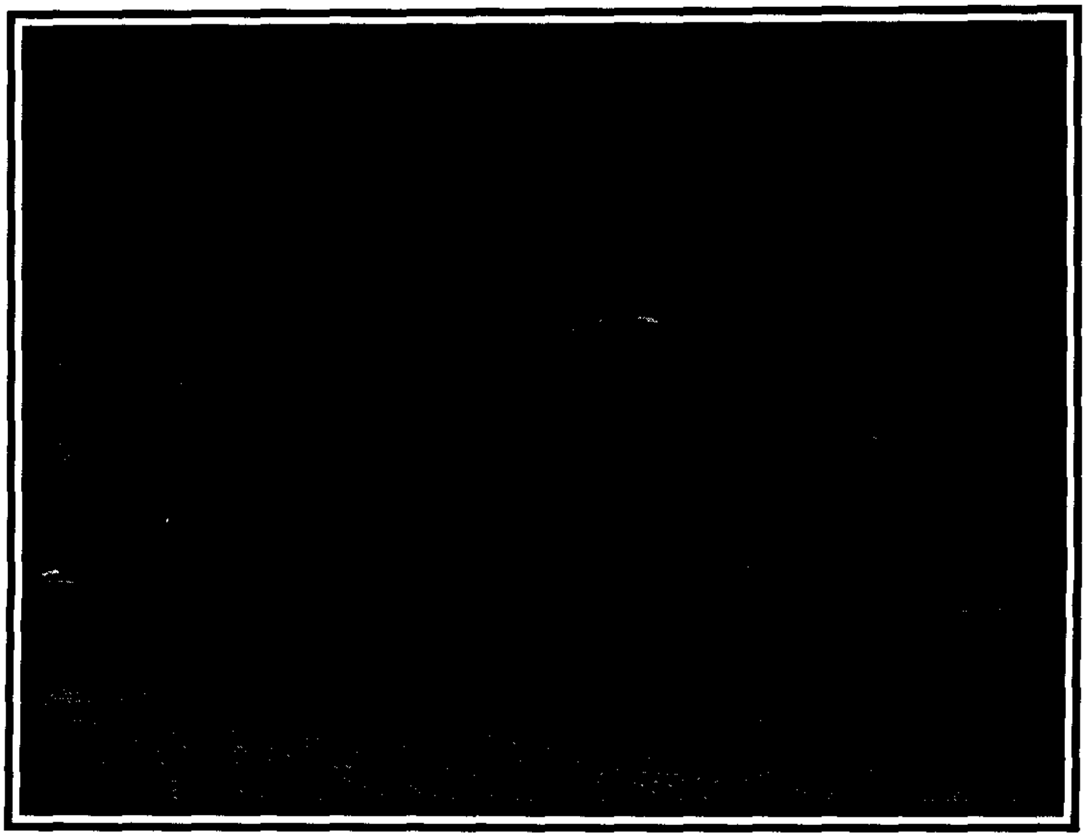


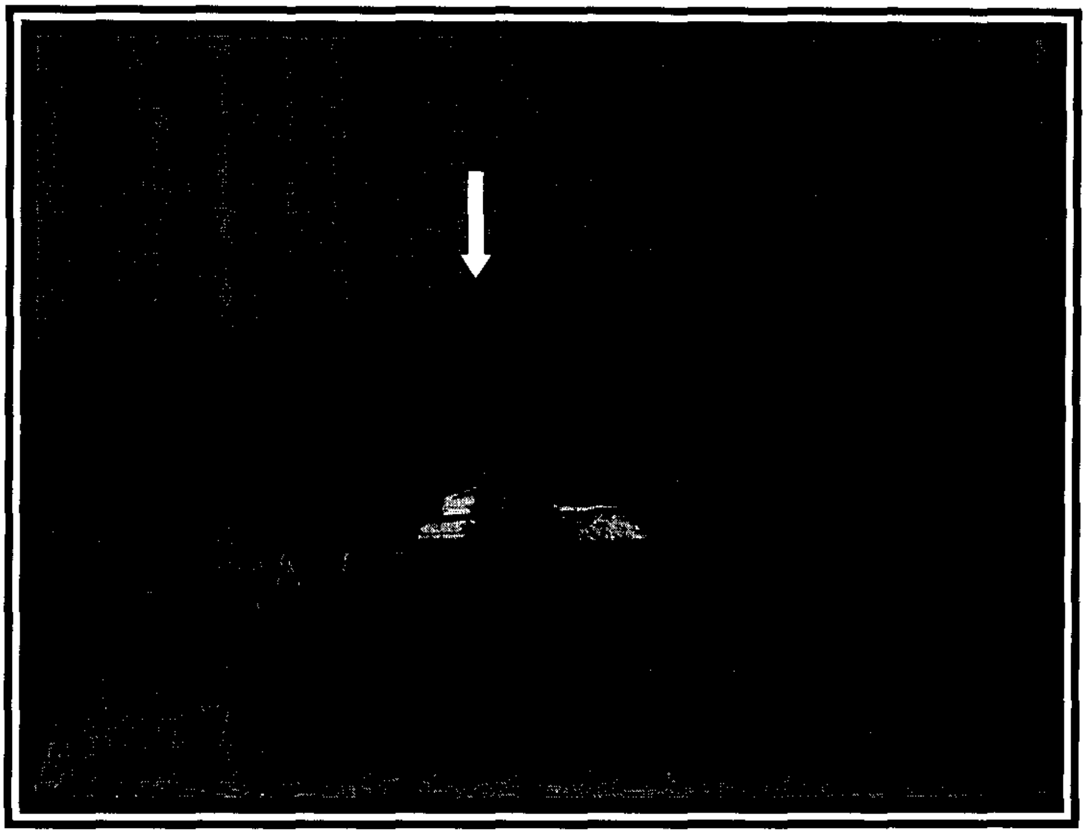
Figure 3.8-2 Measurement Site Photographs

South

West

Figure 3.8-2 (cont.) Measurement Site Photographs

Az 68°



Cell Tower at Az 349°

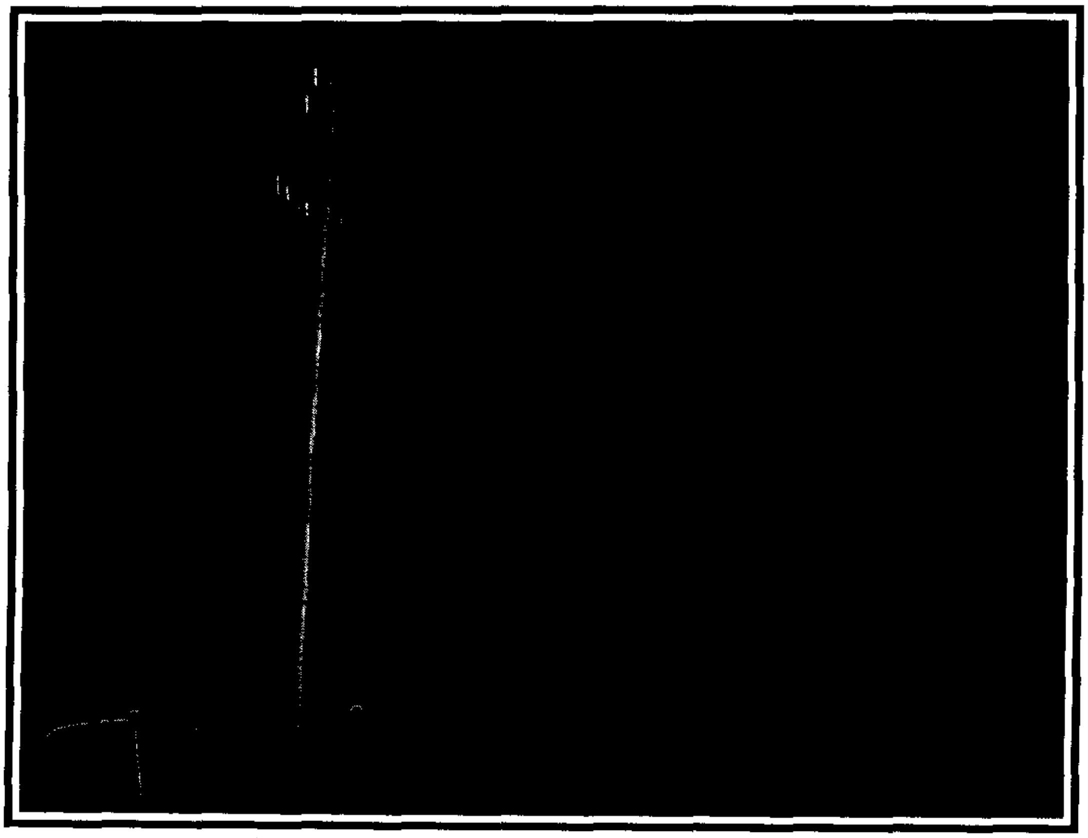


Figure 3.8-2 (cont.) Measurement Site Photographs

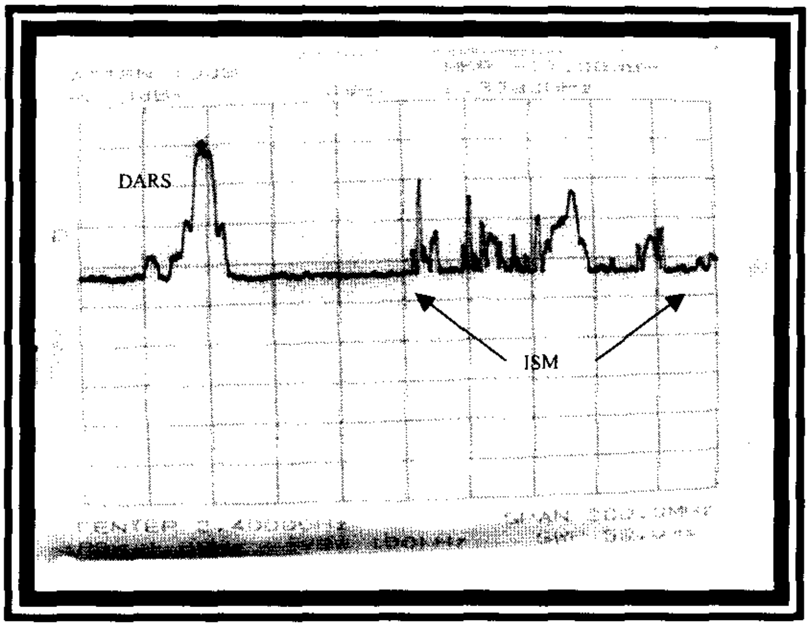
Nokesville, Virginia

Reference Level dBW$_l$

Azimuth 0-360°

XM Radio

-109.5



High-Pass Filter Only

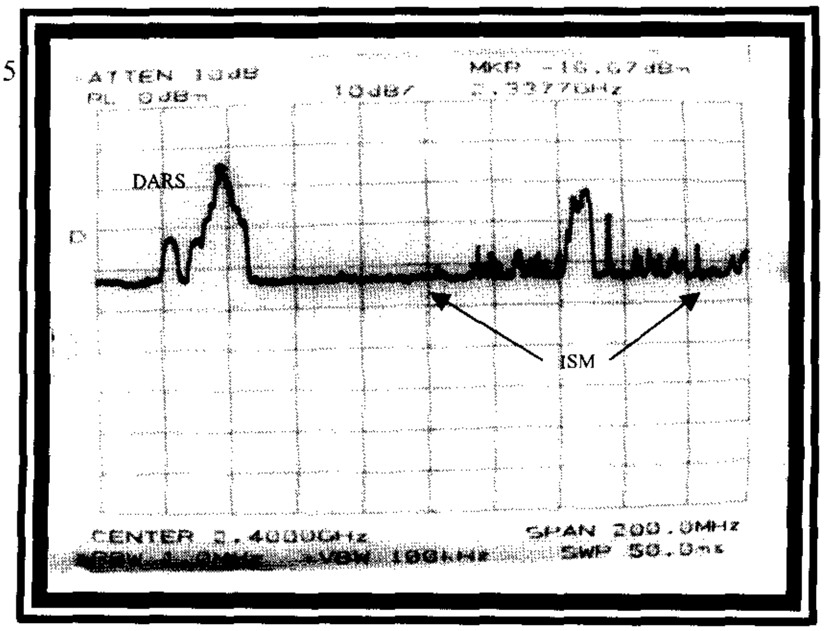
Date: January 21, 2002
Time of Day: 1435
Ant. Polarization: V
Ant. Centerline: 10 Ft.

Full Antenna Sweep

(A)

Reference Level dBW$_l$

-109.5



Date: January 21, 2002
Time of Day: 1440
Ant. Polarization: H
Ant. Centerline: 10 Ft.

Full Antenna Sweep

(B)

Figure 3.8-3 RF Spectrum Analysis

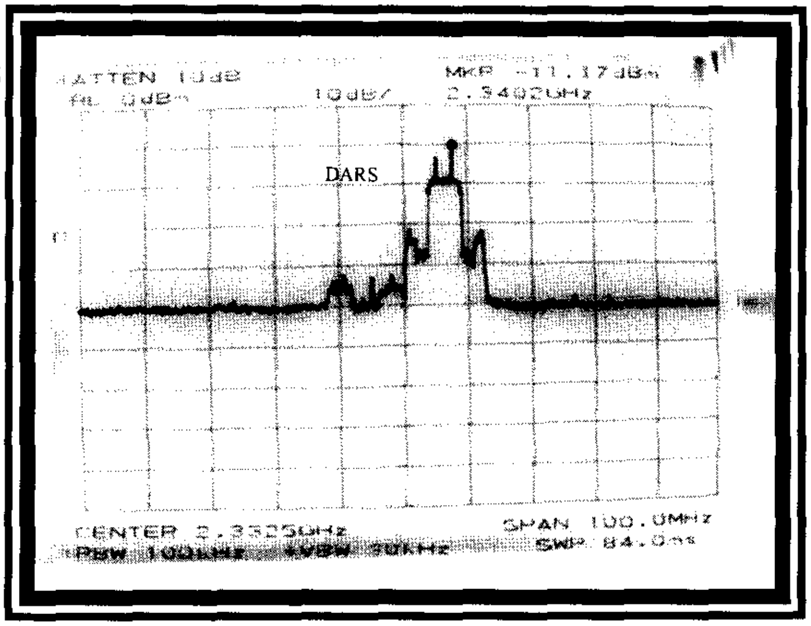
Nokesville, Virginia

XM Radio

Azimuth 0-360°

Reference
Level
dBW_i

-109.5



High-Pass Filter Only

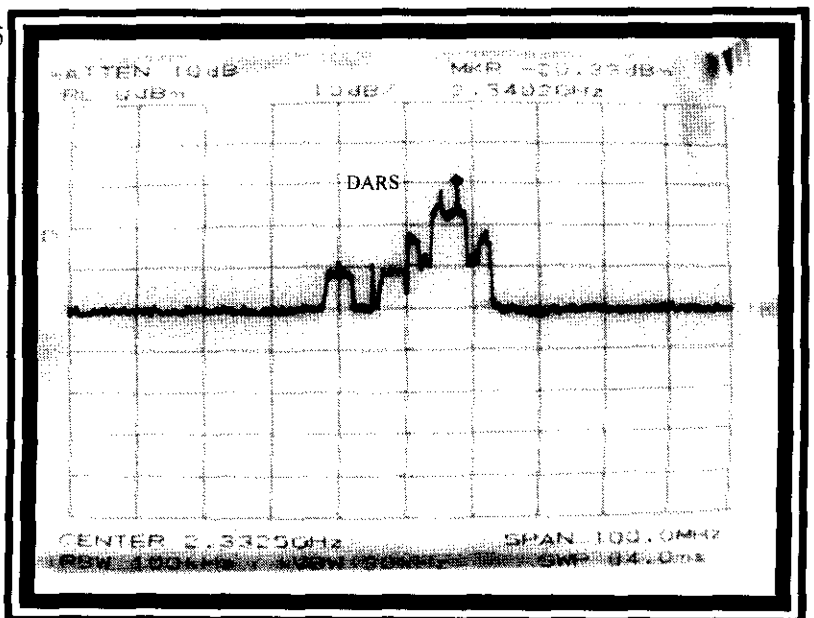
Date: January 21, 2002
Time of Day: 1445
Ant. Polarization: V
Ant. Centerline: 10 Ft.

Full Antenna Sweep

(A)

Reference
Level
dBW_i

-109.5



Date: January 21, 2002
Time of Day: 1450
Ant. Polarization: H
Ant. Centerline: 10 Ft.

Full Antenna Sweep

(B)

Figure 3.8-4 RF Spectrum Analysis

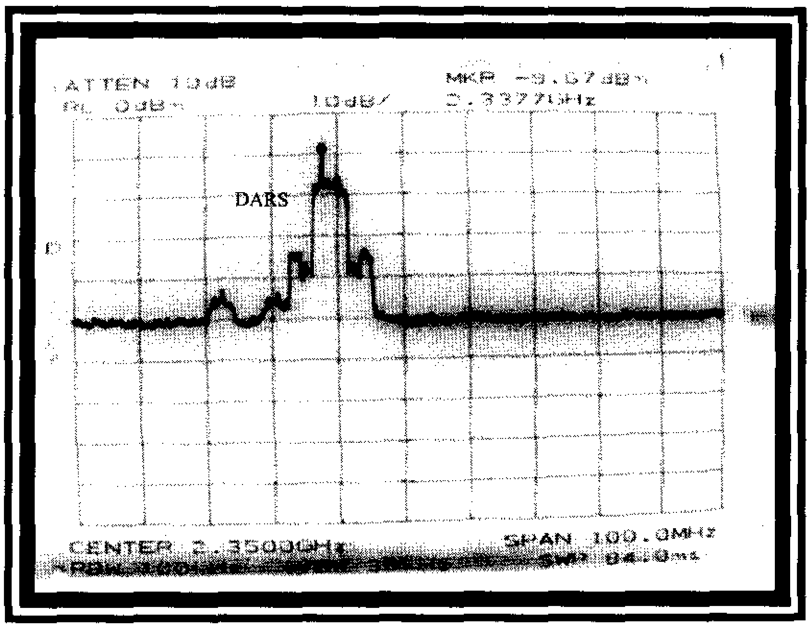
Nokesville, Virginia

Reference Level dBW_1

Azimuth 0-360°

XM Radio

-109.5



High-Pass Filter Only

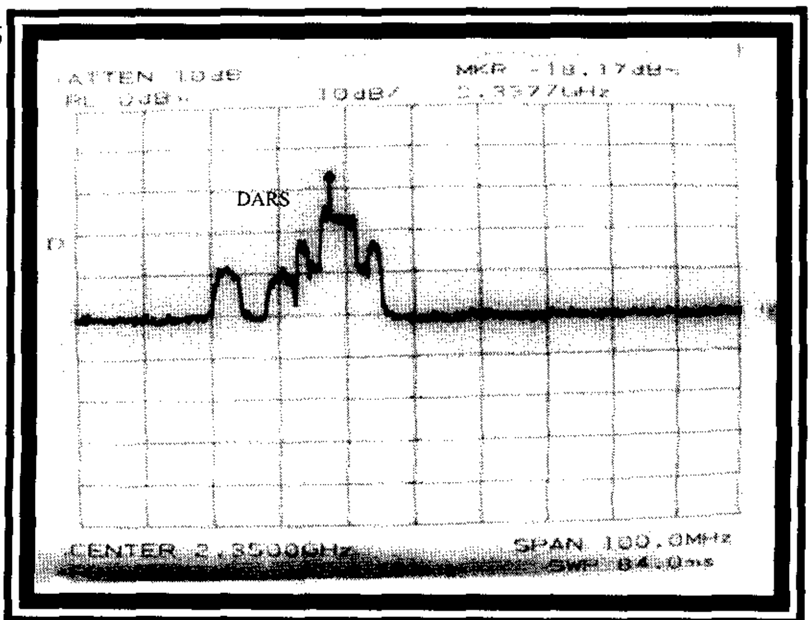
Date: January 21, 2002
Time of Day: 1455
Ant. Polarization: V
Ant. Centerline: 10 Ft.

Full Antenna Sweep

(A)

Reference Level dBW_1

-109.5



Date: January 21, 2002
Time of Day: 1500
Ant. Polarization: H
Ant. Centerline: 10 Ft.

Full Antenna Sweep

(B)

Figure 3.8-5 RF Spectrum Analysis

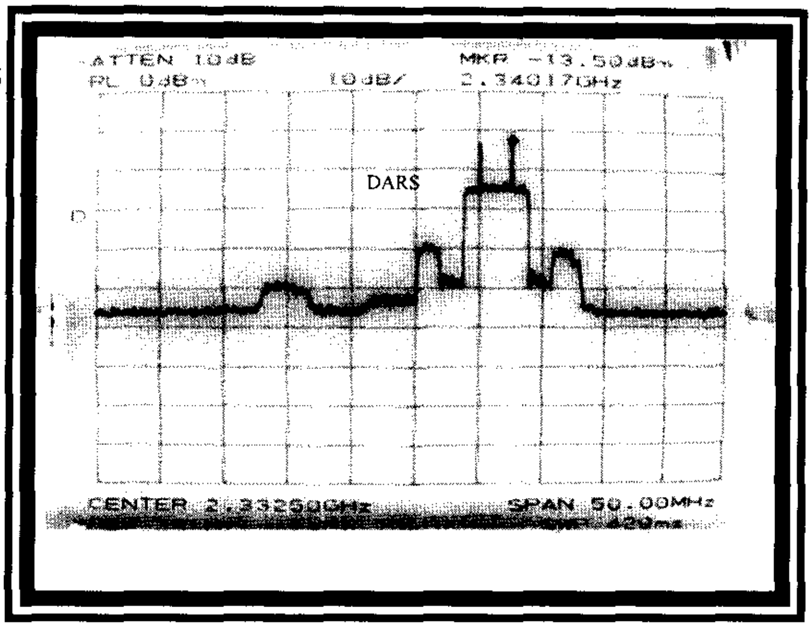
Nokesville, Virginia

Reference Level dBW_1

XM Radio

Azimuth 68°

-109.5



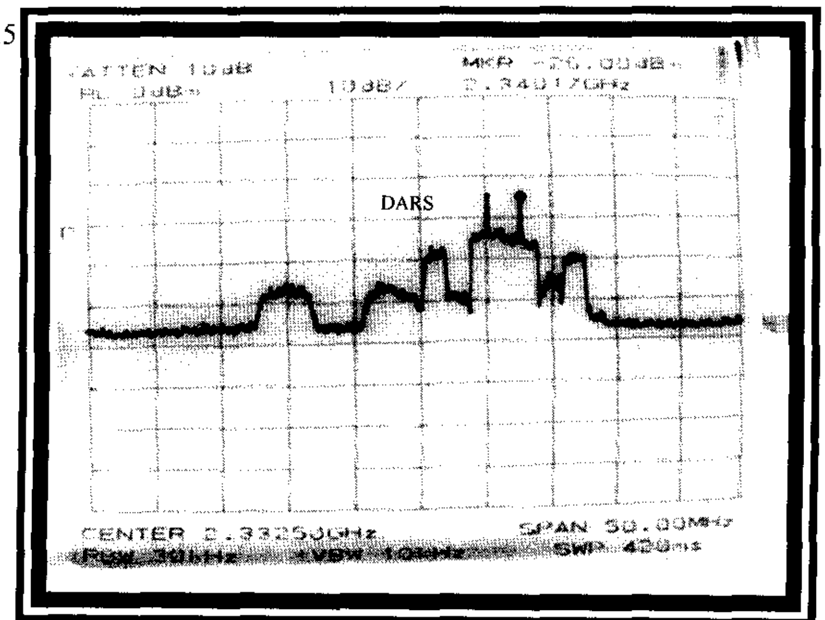
High-Pass Filter Only

Date: January 21, 2002
Time of Day: 1510
Ant. Polarization: V
Ant. Centerline: 10 Ft.

(A)

Reference Level dBW_1

-109.5



Date: January 21, 2002
Time of Day: 1515
Ant. Polarization: H
Ant. Centerline: 10 Ft.

(B)

Figure 3.8-6 RF Spectrum Analysis

SECTION

FOUR

SECTION 4

SUMMARY OF RESULTS

The measurements in this project were performed over a wide range of geographical locations (urban, suburban and rural). Unlike the measurements performed previous to this project the measurements at this time were able to detect the signals from both the XM Radio and Sirius Satellites and the XM Radio repeaters. As a matter of fact, the electromagnetic environment measurements in the urban areas in proximity to the XM Radio repeaters required the use of a notch filter so that the noise level close in to the XM Radio signal could be measured. The measurements were made to a sensitivity level of between -148 to -152 dBW/MHz. See the individual spectrum display figures for the sensitivity of each measurement. At every measurement location there were no signals detected from systems in the adjacent bands or from the WCS band; nor, from any spurious emissions. The ISM band was extremely active, especially in the urban areas and at least one emission consisting of two separate signals was detected in the WCS band. This transmission was believed to belong to COMCAST operating at the high and low B frequencies of the WCS band. When measurements were made close to the highway ignition noise was detected and this can be seen in a number of the spectrum displays.

The electromagnetic environment that was observed at this time in the DARS band is essentially the same as that measured previously and documented in the report referenced in Section 1 of this report. The ignition noise detected was also at levels previously measured. The only difference in the measurements now as compared to the measurements in October of 2000 is that the signals of both the XM Radio and Sirius Satellites and the XM Radio repeater are also present in the environment.

TABLE 4-1
INTERFERNCE LEVELS WITHIN THE DARS BAND
(2320 - 2345 MHz)

LOCATION	INTERFERING FREQUENCY	FIGURE	C/L (Ft.)	SOURCE	MAX LEVEL (dBW/1 MHz)	SYSTEM SENSITIVITY (dBW/1 MHz)
Reagan National Aiport	None	3.1-3(B)	10	N/A	-151	-151
Dulles Airport	None	3.2-3(B)	10	N/A	-152	-152
Reston, VA	Ignition Noise	3.3-4(A)	10	Vehicles	**-140**	-151
Vienna, VA	Ignition Noise	3.3-4(B)	10	Vehicles	**-155**	-152
Leesburg, VA	None	3.5-3(B)	10	N/A	-151	-151
Sterling, VA	Ignition Noise	3.6-4(B)	10	Vehicles	-140	-151
Lucketts, VA	Ignition Noise	3.7-5(B)	10	Vehicles	**-145**	-152
Nokesville, VA	None	3.8-3(A)	10	N/A	-152	-152

NOTES:

Levels in Bold are (dBW/100 KHz)

SECTION

FIVE

SECTION 5

CONCLUSIONS

Based on the measurements performed in this project it is concluded that the electromagnetic environment in the DARS band is virtually the same as it was when the previous measurements referenced in Section 1 were performed. The only signals detected above the noise level of the measurement system in the DARS band and not belonging either to XM Radio or Sirius was ignition noise. Ignition noise of the same magnitude was measured previously and is not considered an interference threat to the reception of the DARS signals. As long as the DARS band electromagnetic environment remains as measured in this project no interference to the operation of the satellite receivers in this band are anticipated.

SURVEY OF THE XM RADIO ELECTROMAGNETIC SPECTRUM IN THE NORTHERN VIRGINIA METROPOLITAN AREA

Prepared For

XM Satellite Radio
1500 Eckington Place
Washington, D.C.

Northern Virginia
XM Frequency Band Testing

October 9, 2000 – October 19, 2000

TABLE OF CONTENTS

SECTION

ONE

SECTION 1

EXECUTIVE SUMMARY

The purpose of the measurements performed in this project was to assess the current electromagnetic environment in the XM Satellite Radio reception band (2332.5 – 2345.0 MHz) to allow comparison to the equivalent input noise level (EINL) of the XM Satellite Radio receivers.

The results of the electromagnetic measurements and data assessment show that the band of operation for the XM Satellite Radio system is electromagnetically quiet enough at the present time so that the XM Satellite Radio receivers should be able to utilize it without suffering from degrading interference. The main source of interference in the band of interest comes from vehicle ignition noise. The ignition noise level is a function of proximity and number of vehicles in a given area. The vertically polarized levels of the ignition noise were generally higher than the horizontally polarized levels. The levels of ignition noise measured were sometimes above the EINL of the XM Satellite Radio receivers, but will have no effect upon the receiver operation due to the fact that they are random in timing and the radio receivers are designed to process time coherent pulses and they don't raise the average noise floor of the receivers. One other signal detected in the band was traced to a home intrusion alarm system installed by Brink's. This signal level was well below the EINL of the XM Satellite Radio receiver. No other signals were detected in-band that could be considered an interference threat to XM Satellite Radio reception.

These measurements were performed at preplanned sites in the Northern Virginia area over a period of two weeks in October 2000. The preplanned sites were chosen to provide a representative sampling encountered in a typical suburban environment from quite residential to heavy-use commercial locations, and were performed at various times throughout the daytime.

The Comsearch test equipment provided a reception capability with an isotopic sensitivity that is at least 20 dB better than the XM Satellite Radio receiver. The test equipment was installed in a company owned Ford Expedition, which served as the test bed for the test equipment and provided transportation from site to site.

Comsearch has been performing electromagnetic environmental measurements and assessments like the one in this project for over 20 years. Our company is recognized and respected by the telecommunication industry and the FCC for our work in this area.

SECTION

TWO

SECTION 2

TEST PROCEDURE

2.1 Calibration

Figure 3.1-1 is the block diagram of the 2332.5 GHz test set. All test equipment used was allowed a proper warm-up period prior to calibration. The test set was calibrated by the signal substitution method, as recommended by NSMA, utilizing a synthesized signal generator. The reference signal from the signal generator was adjusted for the frequency of test (2332.5 MHz) and measured with a thermal power meter for calibrated reference test level (-60 dBm). This calibrated reference signal from the signal generator was then injected into the end of the coaxial cable of the test set at the point, which normally connects to the test antenna. A spectrum analyzer then measured the reference test signal level after passing through the test set. At this point, the spectrum analyzer was calibrated such that the graticule of the spectrum analyzer display (-60 dBm) corresponded to the injected reference signal (-60 dBm) by utilizing the reference level offset function of the Tektronix 2782 spectrum analyzer. Upon completion of the calibration process, a known reference level was obtained for the measurements that corresponds to a given set of spectrum analyzer display readings.

The following formula is used to transform the measured signal level as read on the spectrum analyzer display (dBm) to an isotropic reference signal level (dBm_I) as seen at the point of test:

$$dBm_I = LI - GA$$

Where: dBm_I = Isotropic level in dBm

LI = Level (dBm) of injected signal

GA = Test antenna gain

at 2332.5 MHz:

$$dBm_I = -60 \text{ dBm} - 20 \text{ dB}$$

$$= -80 \text{ dBm}_I$$

In this instance, the spectrum analyzer displayed measured signal level of –60 dBm equates to a isotropic signal level of –80 dBm_I.

Figures 2.1-2 displays the spectrum photograph of the described calibration procedure employed during these measurements.

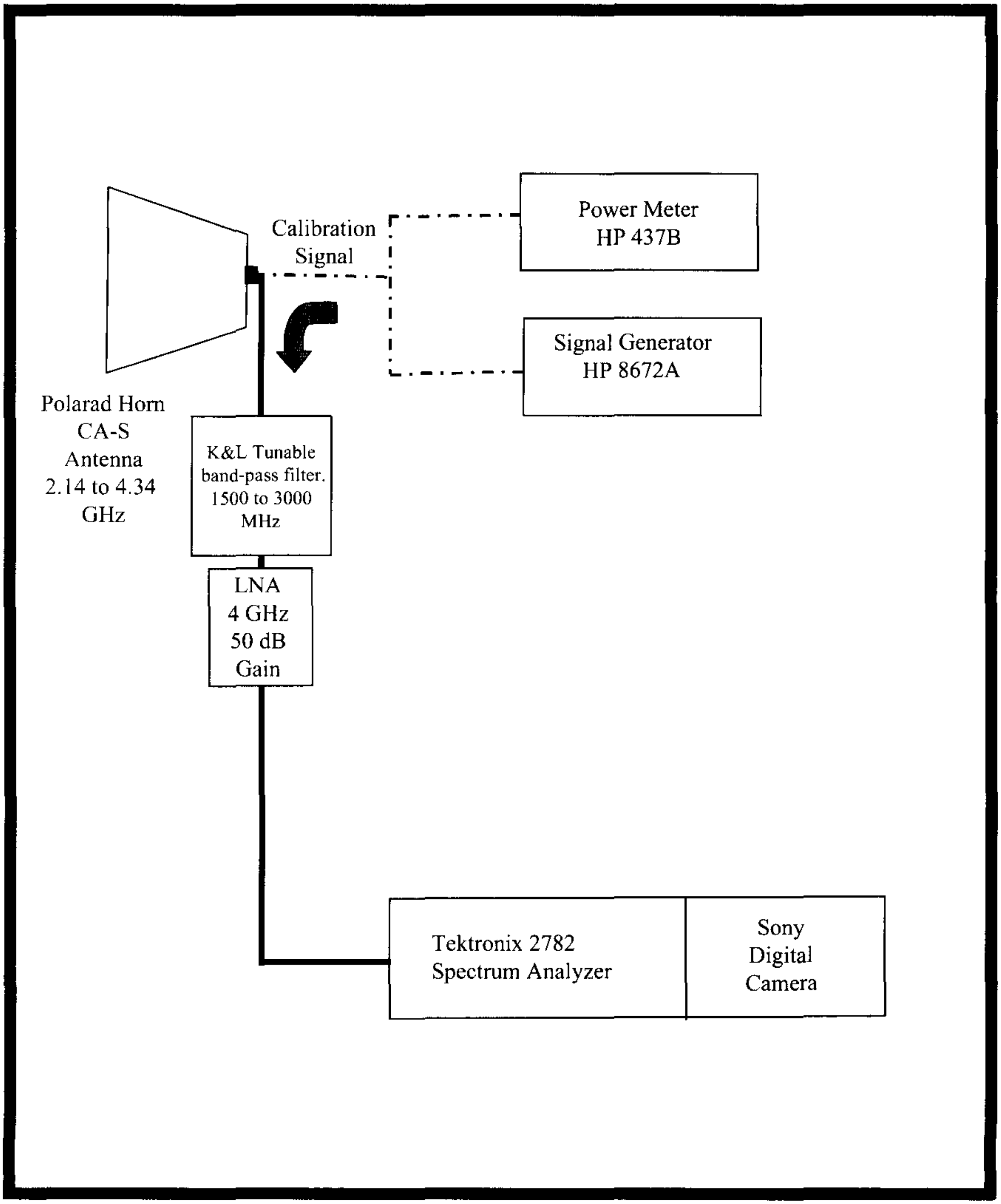


Figure 2.1-1 Receive Test Equipment Block Diagram

COMSEARCH

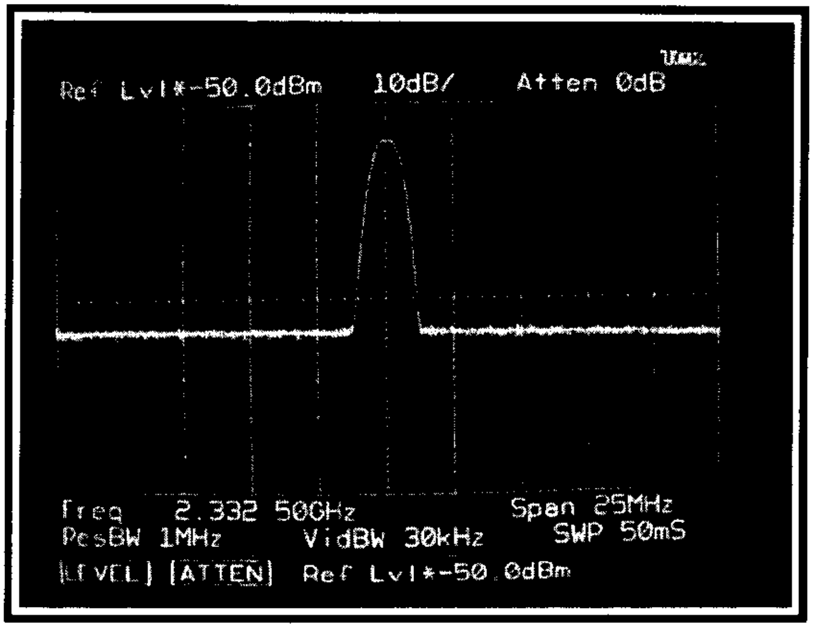
Multiple Measurements – Northern Virginia

Calibration Photograph

XM Satellite Radio

Reference
Level
dBm$_I$

-70



Date: October, 2000
Center Freq: 2332.5 MHz
Span/Div: 2.5 MHz
Res. Bandwidth: 1 MHz
Amplitude/Div: 10 dB

-60 dBm, 2332.5 MHz signal indication on the spectrum photograph represents a –60 dBm signal being injected at the point where the test cable connects to the output of the test antenna.

Displayed Reference Level equals:

-60 dBm injected signal
<u>-20 dB antenna gain</u>
-80 dBm$_I$ Therefore, a displayed signal level of –50 dBm equals a –70 dBm$_I$ isotropic level when using the Polarad CA-5 test antenna.
Noise floor at –130 dBm in a 1 MHz Band width.

Figure 2.1-2 RF Calibration Photograph

2.2 Methodology

Upon arriving at each testing location, site coordinates were obtained using a GPS unit and the site location was plotted on a map. All coordinates were obtained using a GPS unit and are based on NAD 83 datum. In addition, site photographs were taken to visually document the measurement location. All compass readings are in Magnetic North headings. This resulting location information is presented for each site in the Data Presentation (Section 3) portion of this report.

After each sites coordinates and location photograph's were documented, the test equipment was set up and calibrated, as outlined in Section 2.1, to measure the RF environment. Measurements were conducted at each test site in the frequency range of interest from 2320 to 2345 MHz. After the equipment calibration was completed, the test antenna was mounted on a tripod at a height of five (5) feet. As specified by XM Satellite Radio, this height was standardized for all measurement locations. Five (5) feet was used as this is the equivalent of the height above ground of XM Satellite Radio vehicle antenna reception.

Initially, the test antenna was rotated 360 degrees (scanning), once in each polarization, while activating the peak hold function of the spectrum analyzer. This enabled the analyzer to maintain and display the maximum signal level received for all frequencies under consideration. After the initial recording of the 360-degree scans, the maximum amplitude of all individually observed signals in the measurement band was determined as to their frequency, azimuth and received level. The results of these measurements for each location are presented in Section 4 of this report.

SECTION

THREE

SECTION 3

DATA PRESENTATION

This section contains site descriptions, maps, and site and spectrum photographs pertaining to each of the locations measured.

For each measurement location, the frequency range was set to observe the full DARS band from 2320 – 2345 MHz. This places XM Satellite Radio's 12.5 MHz band (2332.5 – 2345.0 MHz) in the upper-half of the spectrum analyzer photographs and the Sirius Satellite Radio band in the lower-half (2320.0 – 2332.5 MHz) of the spectrum analyzer photographs. Although the full DARS band was measured, data presented in this report is confined to XM Satellite Radio upper 12.5 MHz.

As evident in the spectrum photographs, signals were observed at various locations at 2336 and 2339 MHz, which fall within the XM Satellite Radio band. These constant wave (CW) signals were being generated by LCC as part of their drive testing responsibilities for engineering the terrestrial portion of the XM Satellite Radio network. As these signals were being generated as part of the network testing and will not in themselves cause interference to XM Satellite Radio reception, the effect of theses measured signals are not considered in the results of this report. Although the LCC testing signals are identified in each spectrum photograph, the pertinent information provided in each spectrum photograph involves the levels of other measured signals within the 12.5 MHz band of interest.

Following this section, the summary of results for all in-band measurements is presented in Section 4 of this report.

Section 3 Index

Specific sections for each measurement location are as follows:

Section	Location
3.1	Baileys Crossroads, VA – Intersection of Route 7 and Columbia Pike
3.2	Reston, VA – Hechinger Parking Lot at the Intersection of Baron Cameron Avenue and Reston Parkway
3.3	Vienna, VA – Cul-De-Sac of Surveyor Court off of Pleasant Road
3.4	Fairfax, VA – Intersection of Chestnut Street and Park Road
3.5	Reston, VA – 119 Feet SE of Intersection of Hunter Station and Hunters Place
3.6	Fairfax, VA – Intersection of St. Andrews and Connell Road
3.7	McLean, VA – Cul-De-Sac of Santa Maria Court off of Mayflower Drive
3.8	Tyson's Corner, VA – The Approach onto the Inside of I-495 from Dulles Toll Road
3.9	Reston, VA – Intersection of Sunset Hills and Wiehle Avenue
3.10	Maple Hills, VA – George Mason University, on Roanoke Road by the Art Center

SECTION 3.1

Baileys Crossroads, VA

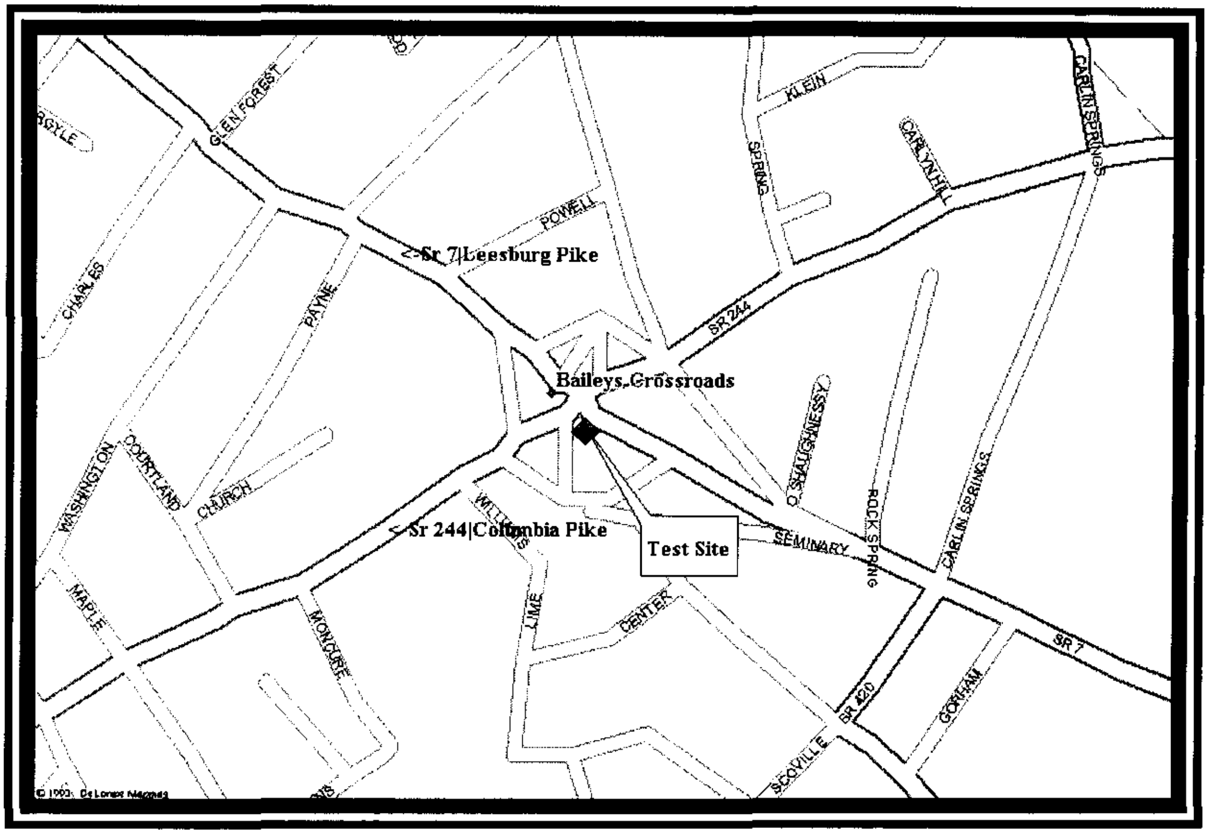
SECTION 3

DATA PRESENTATION

The following section contains the site descriptions, maps, and site photographs and spectrum photographs pertaining to the location measured.

3.1 Baileys Crossroads, Virginia - Intersection of Route 7 and Columbia Pike

- o Figure 3.1-1 presents a site data sheet including all pertinent site information and a site map.
- o Figure 3.1-2 is the photograph depicting the test site.
- o Figures 3.1-3 through 3.1-7 are the RF spectrum photographs depicting the interference environment at the test site.



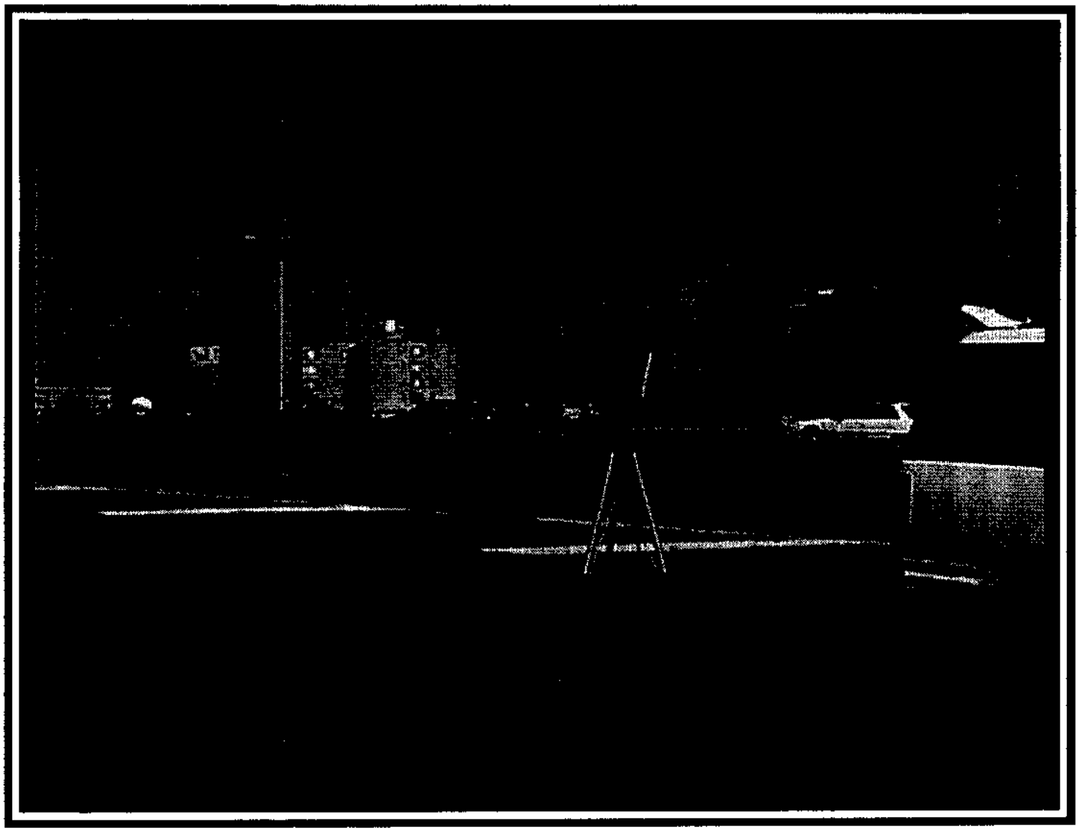
Site Location: Intersection of Columbia Pike and Route 7, **Baileys Crossroads**, Virginia

Type Environment: City, Busy Road, Overpass

GPS Coordinates (NAD 83): 38 50 58.5 N
77 07 43.6 W

Date/Time of Measurement: October 11, 2000/ 11:20 AM to 12:40 PM
October 16, 2000/ 14:00 PM to 14:35 PM

Figure 3.1-1 Measurement Site Date Sheet



Measurment Site Photo: Baileys Crossroads, Virginia

Figure 3.1-1 (cont.) Measurement Site Date Sheet

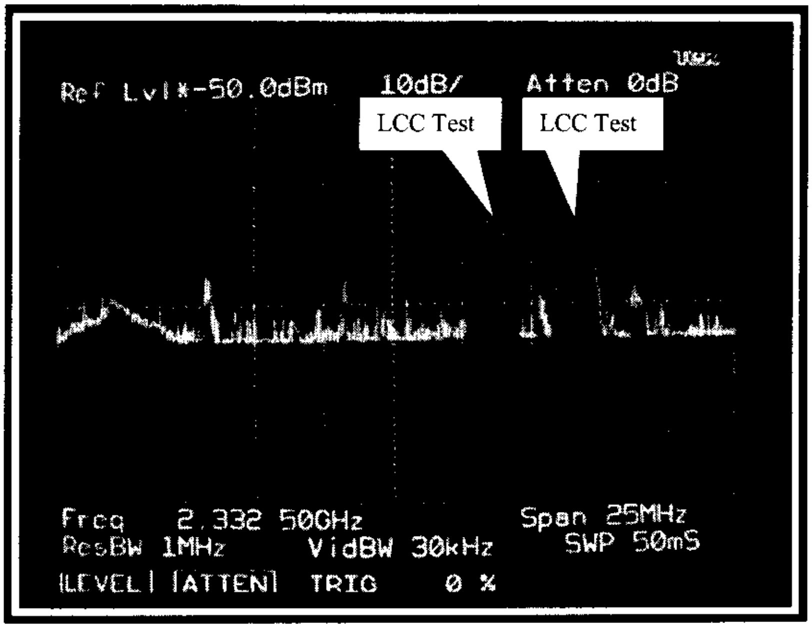
Baileys Crossroads, Virginia

XM Satellite Radio

Azimuth 0-360°

Reference
Level
dBm

-70



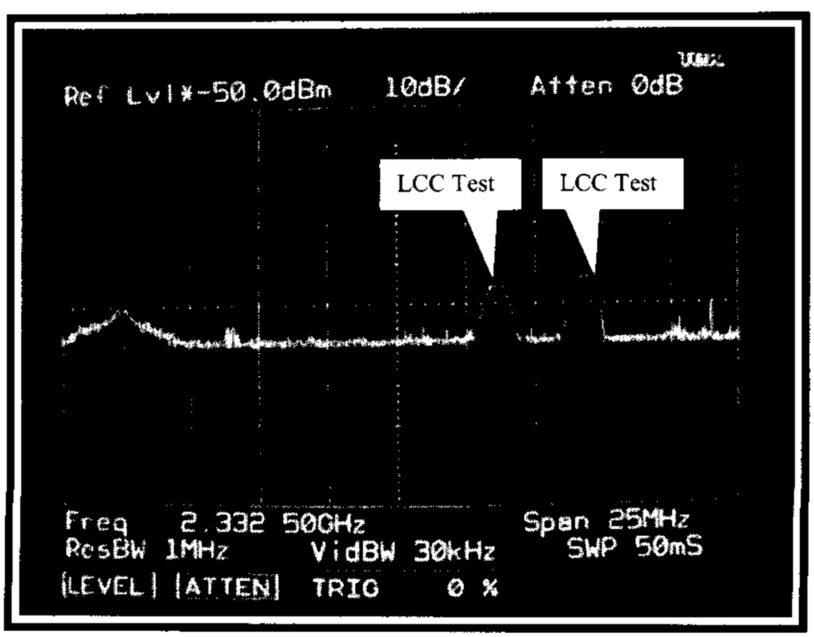
Date: October 10, 2000
Time of Day: 11:54
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(A)

Reference
Level
dBm

-70



Date: October 10, 2000
Time of Day: 11:56
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(B)

Figure 3.1-3 RF Spectrum Analysis

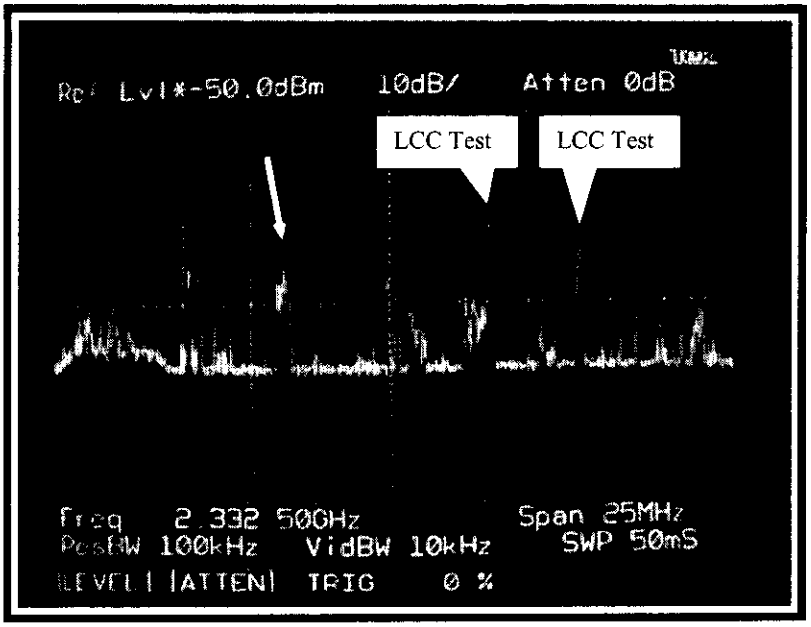
Baileys Crossroads, Virginia

Reference
Level
dBm

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 12:02
Ant. Polarization: V

Full Antenna Sweep

100 kHz Resolution Bandwidth

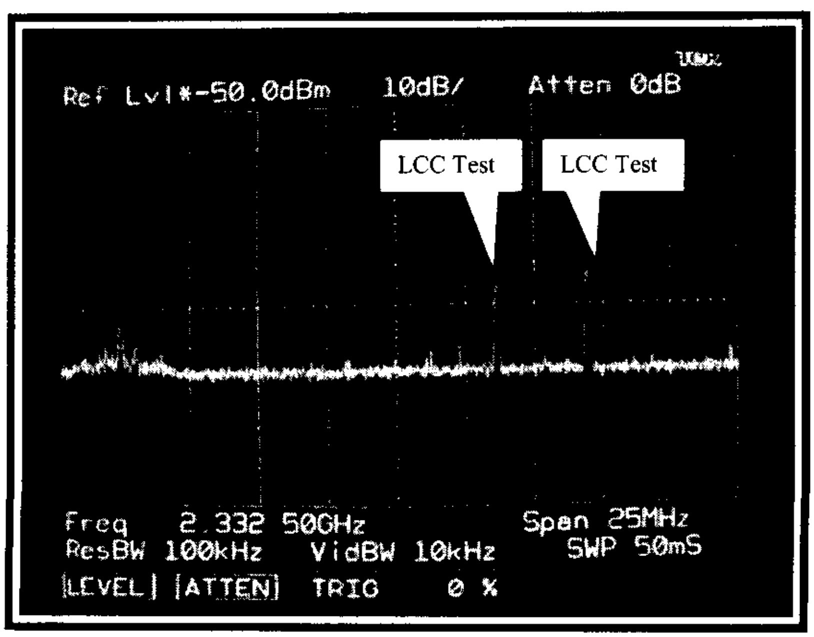
Traffic passing within 25 feet of the test antenna.

Maximum ignition noise interference signal measured was –108 dBm at 2328.75 MHz.

(A)

Reference
Level
dBm

-70



Date: October 10, 2000
Time of Day: 11:59
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

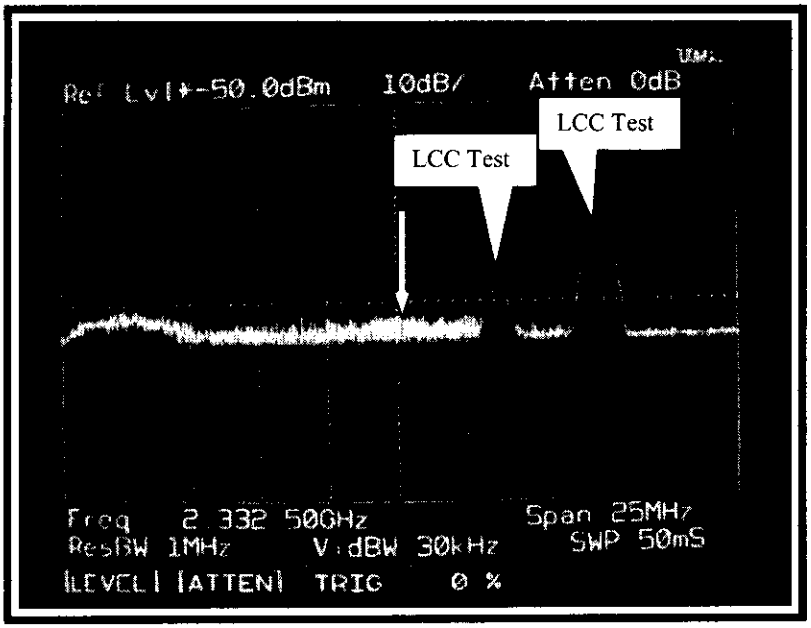
(B)

Figure 3.1-4 RF Spectrum Analysis

Baileys Crossroads, Virginia
Azimuth 181°/Elevation 4°
XM Satellite Radio

Reference
Level
dBm$_I$

-70



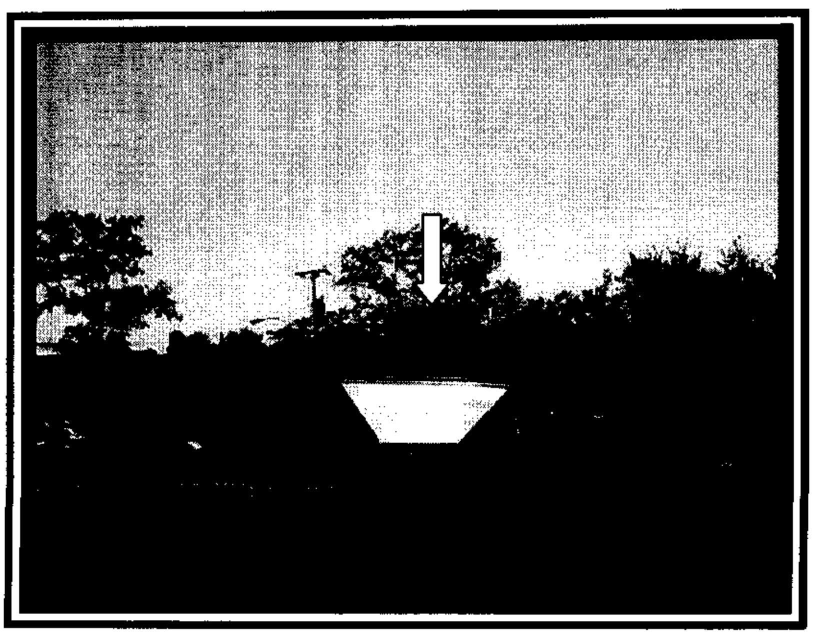
Date: October 10, 2000
Time of Day: 12:32
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm$_I$)
2332.5	**-124.0***

*** Maximum vehicle ignition noise measured as indicated by arrow.**

(A)



Photograph shows the direction of vehicle ignition noise measured above.

(B)

Figure 3.1-5 RF Spectrum Analysis

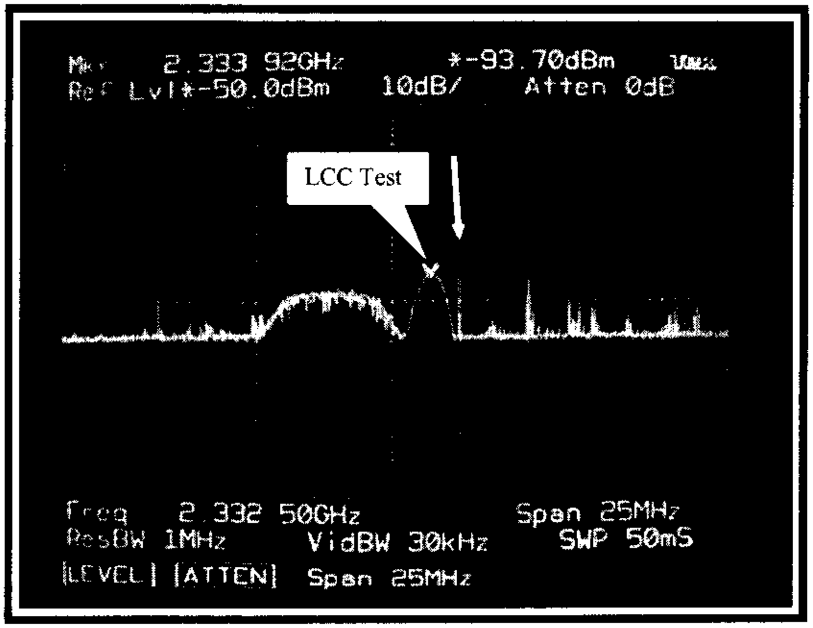
Baileys Crossroads, Virginia

Azimuth 235°/Elevation 2°

XM Satellite Radio

Reference
Level
dBm_l

-70



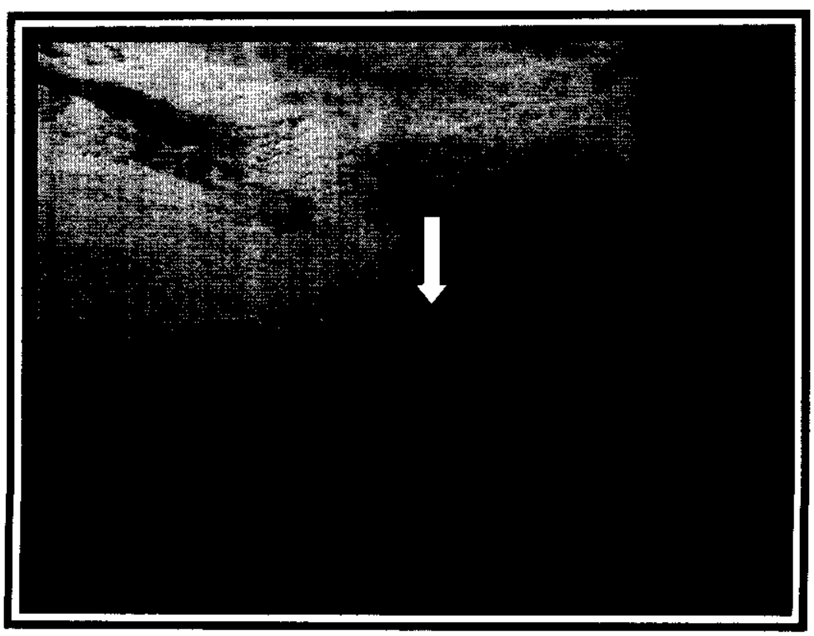
(A)

Date: October 16, 2000
Time of Day: 14:25
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm_l)
2334	**-114.0***

*** Maximum vehicle ignition noise measured as indicated by arrow.**



(B)

Photograph shows the direction of vehicle ignition noise measured above.

Figure 3.1-6 RF Spectrum Analysis

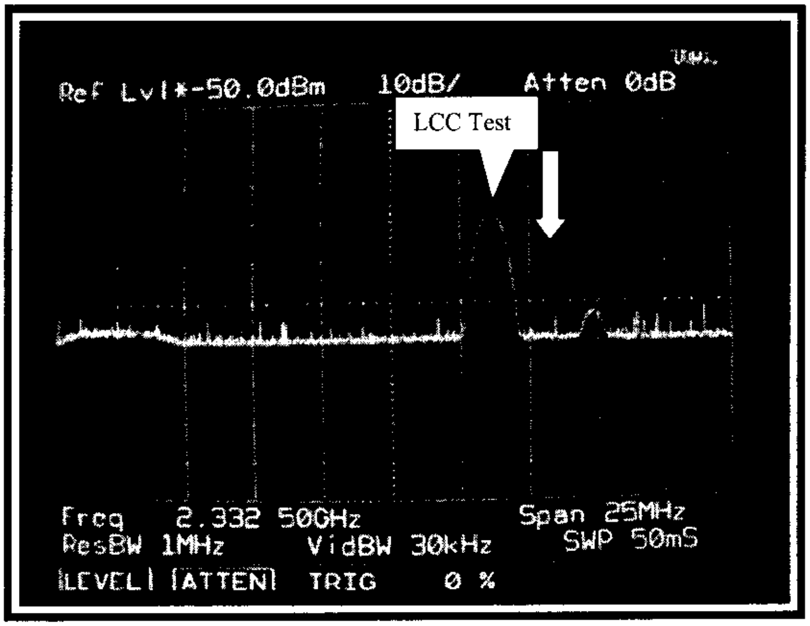
Baileys Crossroads, Virginia

Reference Level dBm$_I$

Azimuth 326°/Elevation 5°

XM Satellite Radio

-70



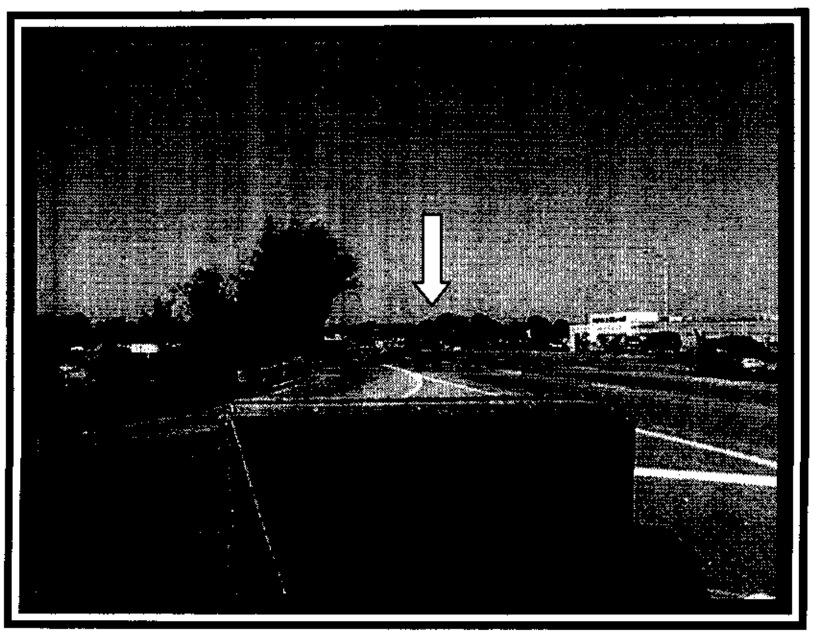
Date: October 10, 2000
Time of Day: 12:27
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm$_I$)
2338.1	**-110.0***

*** Maximum vehicle ignition noise measured as indicated by arrow.**

(A)



Photograph shows the direction of vehicle ignition noise measured above.

(B)

Figure 3.1-7 RF Spectrum Analysis